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Diagnosis of Acute Pulmonary Embolism in the Elderly

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The diagnostic features of acute pulmonary embolism among 72 patients ≥70 years old were evaluated and compared with characteristics of pulmonary embolism among 144 patients 40 to 69 years and 44 patients <40 years old. Syndromes characterized by either 1) pleuritic pain or hemoptysis, 2) isolated dyspnea, or 3) circulatory collapse were observed with comparable frequency among patients ≥70 years old and younger patients. One of these presenting syndromes occurred in 64 (89%) of the 72 patients ≥70 years old. Those who did not show these syndromes were identified on the basis of unexpected radiographic abnormalities, which may have been accompanied by tachypnea or a history of thrombophlebitis.

Among the 72 patients ≥70 years with pulmonary embolism, dyspnea or tachypnea (respirations ≥20/min) occurred in 66 (92%), dyspnea or tachypnea or pleuritic pain in 68 (94%) and dyspnea or tachypnea or radiographic evidence of atelectasis or a parenchymal abnormality in 72 (100%). Complications of angiography were evaluated among patients with and without pulmonary embolism. Major complications of pulmonary angiography among patients ≥70 years old (2 [1%] of 200) were not more frequent than among younger patients (6 [1.1%] of 562) (p = NS). However, renal failure (major or minor) was more frequent in patients ≥70 years old than in younger patients (6 [3%] of 200 versus 4 [0.7%] of 562) (p < 0.05).

The nonspecific manifestations of pulmonary embolism, even among patients ≥70 years of age, are usually present. When necessary, pulmonary angiography can be performed with no greater overall frequency of complications in elderly patients, although renal failure after angiography is a problem in the elderly.

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Pulmonary embolism in the elderly has been thought to be particularly difficult to diagnose because common symptoms, such as dyspnea and hemoptysis may be absent (1) or because elderly patients tend to ignore new symptoms (2). Some investigators (3) found no clinical features that were particularly helpful in reaching a diagnosis, although signs of deep venous thrombosis were observed in 35% of patients. Angiography has been avoided in elderly patients and has been thought by some (3) to be rarely indicated in this age group. The purpose of the present investigation was to evaluate the diagnosis of pulmonary embolism in elderly patients.

Methods

Patient enrollment. Patients reported in this investigation participated in the national collaborative trial of the Prospective Investigation of Pulmonary Embolism Diagnosis (PIOPED) (4). The project protocol and consent forms were approved by the Institutional Review Board at all participating centers. The eligible study patients comprised patients ≥18 years in whom acute pulmonary embolism was of diagnostic concern. Symptoms suggestive of pulmonary embolism within 24 h of study entry (4) were required for inclusion in the study.

Pulmonary embolism was considered to be present if the pulmonary angiogram showed 1) obstruction of a vessel by a thrombus whose trailing edge could be identified, or 2) the outline of an embolus (filling defect) within a vessel.

Among 260 patients in whom pulmonary embolism was determined to be present, 72 patients were ≥70 years of age. Among these, 56 patients were 70 to 79 years and 16 were ≥80 years old. In the present investigation we evaluated these 72 patients and compared them with 144 patients 40 to 69 years and 44 patients <40 years of age who had pulmonary embolism.

Among the 72 patients ≥70 years old with a diagnosis of pulmonary embolism, the diagnosis was established by angiography in 71 (99%) and autopsy in 1 (1%). The diagnosis of pulmonary embolism was excluded in 143 patients ≥70 years of age by negative angiographic findings with or without follow-up in 118 (83%), by follow-up in 3 (2%) with a nondiagnostic angiogram and by follow-up alone in 22 (15%). One patient, aged 87 years, died from a complication of

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angiography, and in that patient the diagnosis of pulmonary embolism was uncertain.

Among the 144 patients 40 to 69 years of age, the diagnosis was established by angiography in 138 (96%), by follow-up that reversed the diagnosis based on normal angiographic findings in 2 (1%) and by follow-up alone in 4 (3%). The diagnosis of pulmonary embolism was excluded in 350 patients 40 to 69 years of age. Among these, pulmonary embolism was excluded by normal angiographic findings with or without follow-up in 271 patients (77%), by follow-up in patients with an uncertain angiographic diagnosis in 12 (3%) and by follow-up alone in 67 (19%).

Among 44 patients <40 years old, the diagnosis of pulmonary embolism was established by angiography in 42 (95%), by follow-up that reversed normal angiographic findings in 1 (2%) and by follow-up alone in 1 (2%). The diagnosis of pulmonary embolism was excluded in 149 patients <40 years of age. Among these 149 younger patients, pulmonary embolism was excluded by normal pulmonary angiographic findings with or without follow-up in 87 (58%), by follow-up in 2 (1%) with uncertain angiographic findings and by follow-up alone in 60 (40%).

Among the 72 patients ≥70 years old with pulmonary embolism, 32 (44%) were men. Among those 40 to 69 years old, 80 (56%) of 144 were men and among those <40 years of age, 24 (55%) of 44 were men.

Protocol. All data were obtained prospectively. A history and physical examination usually were completed before ventilation-perfusion scans were obtained. Although some patients who entered the study directly through an emergency room admission could not have a thorough evaluation before the ventilation-perfusion scan was completed, all physicians who recruited patients made an effort to perform recruitment and evaluation without reference to the scan results.

Chest radiographs were obtained within 24 h of angiography in all patients. A 12-lead electrocardiogram (ECG) was obtained within 24 h of recruitment in 57 patients ≥70 years, 113 patients 40 to 69 years and 36 patients <40 years old. The ECG interpretations were those of the local hospital electrocardiographers.

The partial pressure of oxygen in arterial blood (Pao_2) and the partial pressure of carbon dioxide in arterial blood ($Paco_2$), with the patient breathing room air, were measured within 24 h before the diagnostic pulmonary angiogram. The Pao_2 was measured in 53 patients with pulmonary embolism ≥70 years, 99 patients 40 to 69 years and 37 patients <40 years of age.

Approximate alveolar-arterial (A-a) oxygen gradients were calculated in 52 patients ≥70 years, 98 patients 40 to 69 years and 37 patients <40 years of age. The calculation was made as follows (5):

$$A\text{-a gradient} = 150 - 1.25\ Paco_2 - Pao_2$$

Nuclear ventilation-perfusion scans. Ventilation scans were performed with xenon-133. Perfusion scans were obtained with technetium macroaggregated albumin (Tc-99m MAA). Methods of performance of ventilation-perfusion scans have been described, as have the criteria for interpretation (4). The near-normal/normal category included readings of very low probability by one reader and low probability by the other, very low probability by both, very low probability by one and normal by the other and normal by both.

Pulmonary angiography. Pulmonary angiograms were obtained in the anteroposterior projection with use of 14 in. × 14 in. (35.6 cm × 35.6 cm) film. All angiograms were completed within 24 h and most within 12 h after performance of the ventilation-perfusion scan. Detailed methods for performing the pulmonary angiography have been described (4). Patients whose angiograms were either positive or negative for pulmonary embolism were evaluated for complications of angiography. Angiograms were completed in 755 patients; in an additional 7, angiographic procedures were started but not completed. Complications were therefore evaluated in 762 patients.

Major nonfatal complications of angiography were defined as complications that were life-threatening and, in addition, did not respond promptly to pharmaceutical therapy or required intensive or prolonged treatment in the hospital. Patients who required cardiopulmonary resuscitation, endotracheal intubation, dialysis or blood transfusion were defined as having major complications. Patients who required prolonged monitoring of a complication that spontaneously regressed with no apparent residual damage were considered to have nonmajor or minor complications. Such complications in some instances were therefore important and potentially dangerous events that may have prolonged the hospital stay.

Statistical methods. Comparisons of the prevalence of clinical features among the three age groups were made with a chi-square test for contingency tables. When significant differences within these groups were observed, a chi-square test with Yates' correction was used to identify the specific age group that showed a difference. A Bonferroni correction was used; a probability ≤0.017 was considered significant. A similar method was used to compare the positive predictive values and individual sensitivities and specificities of ventilation-perfusion scans. Sensitivity was defined as the proportion of cases of pulmonary embolism correctly diagnosed. Specificity was defined as the proportion of negative test results among patients who did not have pulmonary embolism. Comparisons of continuous variables were made with Student's *t* test with use of a Bonferroni correction. With this correction, a probability <0.017 was considered significant. Because of the large number of comparisons made in this study, the likelihood that a difference might occur by chance is greater than the reported probabilities suggest. Statistical analyses were performed at Henry Ford Hospital with a data tape provided by the PIOPED data and coordinating center.

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Table 1. Symptoms of Acute Pulmonary Embolism in 260 Patients

	≥70 Years (n = 72)		40 to 69 Years (n = 144)		<40 Years (n = 44)	
	No.	(%)	No.	(%)	No.	(%)
Dyspnea	56	(78)	113	(78)	36	(82)
Pleuritic pain	37	(51)	83	(58)	31	(70)
Cough	25	(35)	60	(42)	20	(45)
Leg swelling	25	(35)	48	(33)	6	(14)
Leg pain	22	(31)	38	(26)	9	(20)
Palpitation	9	(13)	22	(15)	4	(9)
Wheezing	7	(10)	17	(12)	7	(16)
Angina-like pain	7	(10)	19	(13)	3	(7)
Hemoptysis*	6	(8)	6	(4)	14	(32)

*$p < 0.01$, ≥70 years versus <40 years; $p < 0.001$, 40 to 69 years versus <40 years.

Results

Predisposing factors. Immobilization was the most frequent predisposing factor among all age groups. Among the 72 patients ≥70 years old, 48 (67%) were immobilized before the pulmonary embolism, and surgery preceded the pulmonary embolism in 32 (44%). Comparable percentages of patients in the younger age groups were immobilized or underwent surgery before the pulmonary embolism. Malignancy was more frequent among the 72 patients ≥70 years (19 [26%]) than among the 44 patients <40 years old (1 [2%]) ($p < 0.01$); but the 144 patients 40 to 69 years had malignancy nearly as frequently as did patients ≥70 years old (35 [24%]) (p = NS). Estrogen therapy was infrequent among the 40 female patients ≥70 years old (2 [5%]); its use among the 20 female patients <40 years of age preceded pulmonary embolism in 7 (35%) ($p < 0.01$). Childbirth in these 20 patients preceded pulmonary embolism in 5 (25%).

Syndromes of acute pulmonary embolism. Among the 72 patients with pulmonary embolism ≥70 years old, 37 (51%) presented with a syndrome of pleuritic pain or hemoptysis and 20 (28%) with uncomplicated dyspnea (absence of pleuritic pain, hemoptysis or loss of consciousness); 7 (10%) presented with circulatory collapse (blood pressure <80 mm Hg or loss of consciousness). Among these 72 patients, 8 (11%) were identified on the basis of unexplained radiographic findings of atelectasis, pleural effusion or pleural based opacities. These findings were often accompanied by tachypnea or a history of thrombophlebitis, or both. The various presentations were comparable among patients ≥70 years old and younger patients although all patients <40 years of age presented with a syndrome of pleuritic pain or hemoptysis, isolated dyspnea or circulatory collapse.

Symptoms (Table 1). Dyspnea and pleuritic pain were the most frequent symptoms, occurring in 56 (78%) and 37 of 72 (51%), respectively, of the 72 patients with pulmonary embolism ≥70 years old. The frequency of these symptoms was comparable among all age groups. Hemoptysis occurred less frequently among patients ≥70 years or 40 to 69 years than among patients <40 years of age. Other symptoms occurred with comparable frequency among all age groups.

Table 2. Signs of Acute Pulmonary Embolism in 260 Patients

	≥70 Years (n = 72)		40 to 69 Years (n = 144)		<40 Years (n = 44)	
	No.	(%)	No.	(%)	No.	(%)
Tachypnea (respirations ≥20/min)	53	(74)	100	(69)	36	(82)
Rales (crackles)	47	(65)	88	(61)	18	(41)
Tachycardia (heart rate >100/min)	21	(29)	37	(26)	14	(32)
Increased pulmonary component of second heart sound	11	(15)	29	(20)	15	(34)
Deep venous thrombosis	11	(15)	25	(17)	4	(9)
Diaphoresis	6	(8)	14	(10)	8	(18)
Wheezes	6	(8)	14	(10)	2	(5)
Temperature >38.5 C°	5	(7)	7	(5)	6	(14)
Third heart sound	5	(7)	8	(6)	2	(5)
Pleural friction rub	4	(6)	7	(5)	0	(0)
Homan's sign	3	(4)	3	(2)	1	(2)
Cyanosis	2	(3)	5	(3)	1	(2)

Differences among age groups were not significant.

Signs (Table 2). Tachypnea (respiratory rate ≥20/min) was the most frequent sign in all age groups with pulmonary embolism. Among the 72 patients ≥70 years of age, tachypnea occurred in 53 (74%) and tachycardia (heart rate >100/min) in 21 (29%). All signs occurred with a comparable frequency among all age groups.

Chest radiograph (Table 3). The chest radiograph was normal in 3 (4%) of 72 patients ≥70 years old. Atelectasis or pulmonary parenchymal abnormalities were the most frequent radiographic abnormalities among all age groups. All

Table 3. Chest Radiograph in Acute Pulmonary Embolism in 260 Patients

	≥70 Years (n = 72)		40 to 69 Years (n = 144)		<40 Years (n = 44)	
	No.	(%)	No.	(%)	No.	(%)
Normal	3	(4)	11	(8)	6	(14)
Atelectasis or pulmonary parenchymal abnormality	51	(71)	100	(69)	28	(64)
Pleural effusion	41	(57)	66	(46)	20	(45)
Pleural based opacity	30	(42)	49	(34)	19	(43)
Prominent central pulmonary artery	21	(29)	29	(20)	5	(11)
Elevated diaphragm	20	(28)	39	(27)	8	(18)
Cardiomegaly	16	(22)	24	(17)	6	(14)
Decreased pulmonary vascularity	14	(19)	32	(22)	9	(20)
Pulmonary edema	9	(13)	17	(12)	3	(7)
Westermark's sign	5	(7)	11	(8)	0	(0)

Westermark's sign = prominent central pulmonary artery and decreased pulmonary vascularity. Differences among age groups were not significant.

Table 4. Combinations of Signs and Symptoms in 260 Patients With Acute Pulmonary Embolism

	≥70 Years (n = 72)		40 to 69 Years (n = 144)		<40 Years (n = 44)	
	No.	(%)	No.	(%)	No.	(%)
Dyspnea or tachypnea	66	(92)	130	(90)	42	(95)
Dyspnea or tachypnea or hemoptysis	66	(92)	131	(91)	43	(98)
Dyspnea or tachypnea or pleuritic pain*	68	(94)	141	(98)	44	(100)
Dyspnea or tachypnea or signs of deep venous thrombosis	66	(92)	131	(91)	43	(98)
Dyspnea or tachypnea or pleuritic pain or signs of deep venous thrombosis*	68	(94)	142	(99)	44	(100)
Dyspnea or tachypnea or radiographic atelectasis or parenchymal abnormality	72	(100)	140	(97)	43	(98)
Dyspnea or tachypnea or pleuritic pain or radiographic atelectasis or parenchymal abnormality*	72	(100)	142	(99)	44	(100)

*The addition of hemoptysis did not improve the sensitivity of the combination for the detection of pulmonary embolism. Tachypnea = respiratory ratio ≥20/min. Differences among age groups were not significant.

Table 5. Electrocardiographic Findings in 206 Patients With Acute Pulmonary Embolism

	≥70 Years (n = 57)		40 to 69 Years (n = 113)		<40 Years (n = 36)	
	No.	(%)	No.	(%)	No.	(%)
Normal	12	(21)	30	(27)	8	(22)
ST segment or T wave changes	32	(56)	58	(51)	20	(56)
Left axis deviation	10	(18)	12	(11)	3	(8)
Left ventricular hypertrophy	7	(12)	8	(7)	4	(11)
Acute myocardial infarction pattern	7	(12)	4	(4)	2	(6)
Low voltage QRS	5	(9)	6	(5)	0	(0)
Complete right bundle branch block	4	(7)	4	(4)	1	(3)
Right ventricular hypertrophy	2	(4)	3	(3)	1	(3)
Right axis deviation	1	(2)	3	(3)	3	(8)
P pulmonale	1	(2)	2	(2)	0	(0)
Incomplete right bundle branch block*	1	(2)	0	(0)	4	(11)

*$p < 0.01$, 40 to 69 years versus <40 years.

radiographic abnormalities occurred with a comparable frequency among all age groups.

Combinations of symptoms, signs and radiographic abnormalities (Table 4). Dyspnea or tachypnea (respiratory rate ≥20/min) occurred in 66 (92%) of the 72 patients ≥70 years of age; dyspnea or tachypnea or pleuritic pain occurred in 68 (94%) and dyspnea or tachypnea or signs of deep venous thrombosis occurred in 66 (92%). Dyspnea or tachypnea or radiographic evidence of atelectasis or a parenchymal abnormality occurred in 72 (100%). The prevalence of these combinations of manifestations was comparable among all age groups.

Electrocardiogram (Table 5). Nonspecific ST segment or T wave changes were the most common abnormalities, either or both occurring in 32 (56%) of 57 patients ≥70 years old and with the same frequency in younger patients. With the exception of left anterior hemiblock (left axis deviation) among patients ≥70 years of age, other ECG abnormalities occurred in ≤12% of patients in all age groups. No differences in the frequency of occurrence of any ECG abnormalities were apparent between patients ≥70 years old and younger patients, although incomplete right bundle branch block was less frequent among patients 40 to 69 years than among patients <40 years of age.

Partial pressure of oxygen in arterial blood and alveolar-arterial oxygen gradient. The mean (± SD) partial pressure of oxygen in arterial blood (Pao_2) among patients with pulmonary embolism ≥70 years of age, 40 to 69 years old and <40 years of age was 61 ± 12, 67 ± 15 and 75 ± 18 mm Hg, respectively. The Pao_2 was lower among patients ≥70 years than among those <40 years of age ($p < 0.001$). Among patients 40 to 69 years, the Pao_2 was lower than in patients <40 years, but not significantly lower than in patients ≥70 years of age.

The alveolar-arterial oxygen gradient among patients with pulmonary embolism ≥70 years of age was 47 ± 14 mm Hg, a value higher than that among patients 40 to 69 years old (40 ± 17 mm Hg, $p < 0.01$) or <40 years old (31 ± 17 mm Hg, $p < 0.001$).

Clinical assessment. When physicians were 80% to 100% confident that pulmonary embolism was present on the basis of clinical judgment and laboratory tests with the exception of ventilation-perfusion scans, they were correct in 9 (90%) of 10 patients ≥70 years old. When they believed that there was only a small (<20%) likelihood of pulmonary embolism, it was present in 13 (19%) of 69 patients. In most patients physicians were uncertain of the diagnosis, believing that there was a 20% to 79% chance of pulmonary embolism. In these patients ≥70 years old, pulmonary embolism was present in 50 (37%) of 136. The accuracy of clinical assessment was comparable among patients in all age groups.

Ventilation-perfusion scans (Table 6). Among 36 patients ≥70 years of age with ventilation-perfusion scans indicating a high probability of pulmonary embolism, 34 (94%) had pulmonary embolism. The positive predictive value of all probabilities of ventilation-perfusion scans was comparable in all age groups.

The sensitivity of ventilation-perfusion scans indicating a high probability of pulmonary embolism among patients ≥70 years of age (34 [47%]) did not differ significantly from the sensitivity of such scans among younger age groups. The

Table 6. Results of Ventilation-Perfusion Scans in Acute Pulmonary Embolism

Scan Result	≥70 Years		40 to 69 Years		<40 Years	
	No. of Pts	(%)	No. of Pts	(%)	No. of Pts	(%)
High	34/36	(94)	60/68	(88)	11/16	(69)
Intermediate	27/100	(27)	59/199	(30)	22/52	(42)
Low	10/71	(14)	24/172	(14)	8/57	(14)
Near normal/normal	1/8	(13)	1/55	(2)	3/68	(4)

Differences among age groups were not significant. No. of Pts = number of patients with pulmonary embolism/number of patients with the scan result shown in column 1. High, intermediate and low = high, intermediate or low probability of pulmonary embolism.

specificity of ventilation-perfusion scans indicating a high probability of pulmonary embolism among patients ≥70 years old (141 [99%] of 143) was similar among patients 40 to 69 years of age (342 [98%] of 350) and among patients <40 years old (144 [97%] of 149) (p = NS).

Complications of pulmonary angiography among patients with and without pulmonary embolism. Neither major nor minor complications of pulmonary angiography were more frequent among patients ≥70 years of age than among the younger patients. Major complications occurred in 2 (1%) of 200 patients ≥70 years, in 5 (1.2%) of 427 patients 40 to 69 years and in 1 (0.7%) of 135 patients <40 years old (p = NS). One fatal complication occurred in an 87-year old woman who suffered from ventricular tachycardia followed by hypotension and respiratory arrest; she died 12 h after the procedure.

Renal failure, either major or minor, was the most frequent complication of angiography among elderly patients; it occurred in 6 (3%) of 200 patients compared with (4 [0.7%] of 562) patients ≤69 years of age ($p < 0.05$). The "minor" complications of renal failure were important complications, although dialysis was not required. Patients with these complications showed either an elevation of the serum creatinine from previously normal levels to ≥2.1 mg/100 ml (range 2.1 to 3.5 mg/100 ml) or an increase in a previously abnormal serum creatinine level ≥2 mg/100 ml. All but one patient who developed renal failure after angiography was >60 years old. The exception was a 52-year old woman who had worsening of chronic renal failure after angiography. Among the 10 patients who developed renal failure, 3 required dialysis.

Among patients 40 to 69 years of age, five (1.2%) of 427 had a major complication including death in two (cardiopulmonary arrest that occurred during angiography in one and 1 h after the procedure in one). Renal failure that required dialysis occurred in two patients and respiratory distress that required endotracheal intubation occurred in one patient.

Among patients <40 years of age, 1 (0.7%) of 135 had a major complication: a nonfatal respiratory arrest that required cardiopulmonary resuscitation.

Minor complications included urticaria, pulmonary edema requiring only diuretics, nausea and vomiting, arrhythmias that were not life threatening, hematomas, interstitial staining with contrast material and narcotic overdose. Minor complications occurred in 14 (7%) of 200 patients ≥70 years old, in 22 (5.2%) of 427 patients 40 to 69 years of age and in 8 (5.9%) of 135 patients <40 years old (p = NS).

Discussion

Diagnosis of pulmonary embolism in the elderly. The signs, symptoms, chest radiographic abnormalities and electrocardiographic features of acute pulmonary embolism are nonspecific but, when considered together, the array of manifestations are usually sufficiently characteristic to identify a need for ventilation-perfusion scans or pulmonary angiography, or both (6–8). The diagnosis of pulmonary embolism among elderly patients has been thought to be particularly difficult because the expected signs and symptoms may be absent (1–3). The present study showed that most clinical manifestations occurred with a comparable prevalence among patients ≥70 years of age and younger patients. The usual syndromes of pulmonary embolism, characterized by either pleuritic pain or hemoptysis, isolated dyspnea or circulatory collapse were observed with comparable frequency among elderly patients and younger patients. However, some patients ≥70 years of age (11%), in contrast to younger patients, did not show these syndromes. They were identified on the basis of unexpected radiographic abnormalities, which may have been accompanied by tachypnea or a history of thrombophlebitis. Unexplained radiographic abnormalities may be an important clue to the diagnosis of pulmonary embolism, particularly among elderly patients in whom the expected signs and symptoms are absent, as has previously been observed (1). Nevertheless, even among patients ≥70 years old, a combination of nonspecific symptoms and signs that typically occur with pulmonary embolism was present in the great majority. Only a small percent of patients ≥70 years of age with pulmonary embolism did not have dyspnea, tachypnea or pleuritic pain.

One might speculate that pulmonary embolism may have been overlooked in some elderly patients who had no clinical manifestations of this condition. It is unlikely that there were many such patients. To have been overlooked, such patients would have had to recover without further sequelae and without treatment or they would have had to die before showing any further clues to the diagnosis. Both are unlikely events. Any patient who had a ventilation-perfusion scan or

a pulmonary angiogram was identified as a potential candidate for inclusion in the study.

Ventilation-perfusion scans and pulmonary angiography. The utility of ventilation-perfusion scans among patients ≥70 years old was comparable with that in younger patients. Pulmonary angiography was not more hazardous among the elderly, although renal failure was a more frequent sequela among patients ≥70 years of age than among younger patients. All of the patients who developed renal failure were >60 years of age, with the exception of a 52-year old woman who had chronic renal failure before angiography. The definitions of major complications were intentionally conservative. The frequency of major complications therefore may tend to be overestimated.

Conclusions. The nonspecific manifestations of pulmonary embolism, even among patients ≥70 years old, occur with sufficient frequency to suggest the possibility of pulmonary embolism in the differential diagnosis. The typical signs and symptoms known to occur among younger patients were common, even among elderly patients, although occasional exceptions were observed. In the absence of these signs and symptoms, unexplained radiographic abnormalities are important diagnostic clues. When the diagnosis of pulmonary embolism is uncertain, pulmonary angiography can be performed in elderly patients with no greater overall risk than in younger patients, although renal failure was a problem among elderly patients.

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